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ABSTRACT

Discussed is a survey of 235 institutions granting Ph.D. degrees. Findings showed that since 1975 the proportion of recent doctorates on the full-time faculty of 5 representative science and engineering fields has dropped by one-fifth. The number of full-time doctoral faculty increased by over 14% between 1968 and 1978, but the number of recent doctorates (defined as degrees held seven years or less) decreased by 39%. Data are presented on the professional activity of the recent doctoral faculty. (RE)

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nsf SCIENCE RESOURCES STUDIES HIGHLIGHTS

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Decline in Recent Science and Engineering Doctoral Faculty Continues into 1978

These Highlights are from a survey sponsored by the National Science Foundation and conducted by the Higher Education Panel of the American Council on Education. The Higher Education Panel conducts an ongoing survey research program—primarily supported by Federal funds—based on a stratified sample of 760 of the more than 3,000 universities and colleges in the United States. This survey used a sample of 235 institutions to represent the total of 288 Ph.D.-granting institutions. Heads of doctoral-level departments in 16 science and engineering (S/E) fields were asked to provide information. Responses were received from 86 percent of the institutions surveyed.

Assessment Highlights

• The role of recent doctoral faculty[1] in the academic community is considered by many to be an important factor in the vitality of the academic enterprise. The ages of the recent doctoral group generally range from the midtwenties to the midthirties. The proportion of recent doctorates in the full-time faculty of 16 representative S/E fields was 24 percent in 1978—down from 28 percent in 1975—and 42 percent in 1968. Since 1975 the proportions of recent doctorates have dropped by one-fifth or more in biochemistry, biology, botany, electrical engineering, and physics.

• The total number of full-time doctoral faculty increased by over 14 percent between 1968 and 1978 but the number of recent doctorates decreased by 39 percent during this same period.

• In the opinion of university S/E department heads, about three-tenths of the doctoral faculty should be recent doctorates. Applying the department head's standard to the total S/E doctoral faculty of approximately 36,000, the composition should have included about 2,100 more recent doctorates in 1978. The greatest differences were in physics and chemistry. The only field that had a sufficient proportion of recent doctorates was economics.

• Recent doctoral faculty were more active than their senior colleagues in submitting research proposals during the 1976–77 period. They submitted slightly more than one proposal per person compared to .86 per senior doctorate. The greatest differences were observed in botany, chemical engineering, and sociology, with the recent doctorates in these fields being approximately 70 percent more active than their senior colleagues.

• In general, according to department heads, recent doctoral faculty were more likely to apply for independent research support now than five years ago. This opinion was expressed by 47 percent of the department heads surveyed, while an additional 38 percent said that there had been no change.

• For all fields combined, the recent doctorates were experiencing about the same success as their senior colleagues in terms of proposals that had been funded as of the time of the survey—55 percent compared to 59 percent. For both groups, decisions had not been made on about 12 percent of the proposals submitted.

Introduction

Since at least the midsixties, there has been concern about balance in the age composition of university and college faculty. The higher education community first began to give serious consideration to the implications of the declining number of births in this country at a time when there still was very rapid increase in faculty, especially young faculty. Now, in almost all fields there are fewer recent doctorates than desired by university S/E department heads. For the near term, the prospects are not promising for attaining a faculty age distribution considered desirable by these department heads.

The widespread belief that the proportion of recent doctoral faculty is directly related to the vitality of the academic enterprise is based largely on impressions rather than results of systematic investigations. In *The Structure of Scientific Revolutions*, Thomas S. Kuhn stated, "This generalization about the role of youth in fundamental scientific research is so common as to be a

[1] Defined as those who have held the doctorate for seven years or less.

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cliché. Furthermore, a glance at almost any list of fundamental contributions to scientific theory will provide impressionistic confirmation. Nevertheless, the generalization badly needs systematic investigation."[2] Recent studies by Stephen Cole and Nancy Stern have concluded that a scientist's age is not significantly correlated with productivity or with the quality of work published.[3] From their evidence, however, it can be argued that young scientists are at least as productive of quality research as their older colleagues.

For scientists holding full-time faculty positions at universities, there are other important reasons for concern about the proportion of recent doctorates.[4] In most universities, new faculty are evaluated for tenure after a probationary period of usually five to seven years. Those who receive tenure, presumably the more productive in teaching, research, and public service, are retained on the faculty. Department heads have indicated that, on average, approximately 30 percent of the faculty should be recent doctorates.[5] Presumably, this level enables the tenure evaluation to provide the desired quality control.

Trends in Proportion of Recent Doctorates

The 1,809 departments surveyed in 16 representative S/E fields had 35,962 regular full-time doctoral faculty in 1978 (table 1). This number is about 68 percent of the total estimated number of full-time S/E faculty of all degree levels at all doctorate-granting institutions for that year.

Beginning in 1968 the National Science Foundation has conducted several studies of the proportion of recent doctoral faculty in doctoral-level S/E departments. This proportion has dropped from 42 percent in 1968 to 24 percent in 1978 (chart 1).

In all fields except economics, the proportion of recent doctoral faculty is now below the level considered desirable by department heads in a 1975 NSF-sponsored survey.[6] The greatest disparities are in biochemistry and physics which have only about one-half the desired percentage of recent doctoral faculty (table 2). In 12 of the 16 fields surveyed, the 1978 proportions of recent doctoral faculty are below the levels that the respondents to the 1975 survey expected to be reached by 1980. Since 1975 the proportions of recent doctorates have dropped by one-fifth or more in biochemistry, biology, botany, electrical engineering, and physics.

There is no universally accepted standard for the most effective proportion of recent doctorates in the full-time S/E faculty in these departments. In 1975 the heads of these departments indicated that this proportion should be 0.3. If one assumes that these desired proportions have remained constant over time, then the composition of the total S/E doctoral faculty—approximately 36,000—should have included about 2,100 more

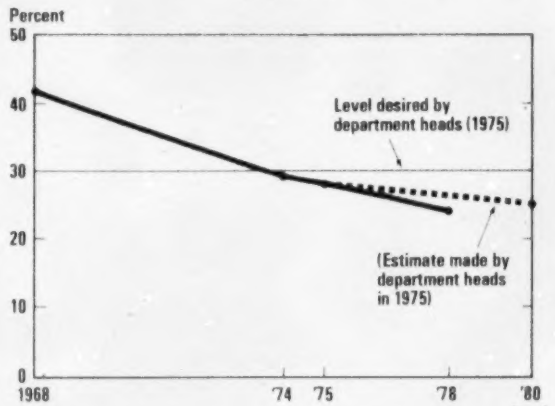
Table 1. Full-time doctoral faculty and recent doctoral faculty in selected doctoral-level science/engineering departments: 1978

Field	Number of depts	Doctoral faculty		
		Total	Recent doctorates	
			Number	Percent
All selected departments	1,809	35,962	8,652	24
Biochemistry	129	1,746	294	17
Biology	134	3,132	724	23
Botany	50	842	139	17
Chemical engineering	96	994	208	21
Chemistry	183	3,994	690	17
Economics	115	2,468	845	34
Electrical engineering	113	2,355	479	20
Geology	97	1,319	305	23
Mathematics	151	4,845	1,298	27
Microbiology	122	1,385	328	24
Mining & mineral engineering	11	108	25	24
Physics	156	3,781	488	13
Physiology	104	1,505	405	27
Psychology	174	4,344	1,382	32
Sociology	121	2,140	775	36
Zoology	47	998	259	26

Note: Because independent weighting procedures were used for each field, detail may not add to total. Percentages are based on the true proportions of the weighted numerical values.

Source: American Council on Education

Chart 1. Proportion of recent full-time doctoral faculty in selected doctoral-level science/engineering departments: selected years



NOTE: The lines connecting the points are intended as visual aids only. The values for years between surveys may not lie on these straight lines.

SOURCE: National Science Foundation and American Council on Education

[2] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, (Chicago, Ill. 60637: The University of Chicago Press, 1970), p. 90.

[3] Nancy Stern, "Age and Achievement in Mathematics: A Case-Study in the Sociology of Science," *Social Studies of Science*, VIII, 1, 1978, p. 128, and Stephen Cole "Age and Scientific Performance," *American Journal of Sociology*, LXXXIV, 4, 1979.

[4] Although not all scientists and engineers are young in age when they receive the doctorate, most of those who have held the doctorate seven years or less are in fact young. In recent years the median age for new recipients of doctorates in S/E fields has been 30 years. See National Academy of Sciences, *Summary Report: Doctorate Recipients from United States Universities*, (Washington, D.C.), annual series.

[5] Frank J. Atelsek and Irene L. Gomberg, *Young Doctorate Faculty in Selected Science and Engineering Departments, 1975 to 1980*, (Washington, D.C.: American Council on Education, Higher Education Panel Reports, Number 30), 1976. The desired proportion of recent doctorates varied by field, ranging from 26 percent in chemistry to 37 percent in sociology.

[6] Frank J. Atelsek and Irene L. Gomberg, *Young Doctorate Faculty in Selected Science and Engineering Departments, 1975 to 1980* op. cit.

Table 2. Difference between actual and desired percentages of recent full-time doctoral faculty in selected doctoral-level science/engineering departments: 1978

Field (Rank ordered by column 1)	Recent doctorates as percent of total doctoral faculty (1)	Percentage of recent doctorates desired by department heads[1] (2)	Difference between actual and desired percentage (3) = (1)–(2)
Sociology	36	37	–1
Economics	34	33	+1
Psychology	32	34	–2
Mathematics	27	31	–4
Physiology	27	34	–7
Zoology	26	31	–5
All selected departments	24	30	–6
Mining & mineral engineering	24	32	–8
Microbiology	24	30	–6
Biology	23	30	–7
Geology	23	28	–5
Chemical engineering	21	27	–6
Electrical engineering	20	29	–9
Chemistry	17	26	–9
Botany	17	27	–10
Biochemistry	17	31	–14
Physics	13	27	–14

[1] Frank J. Atelsek and Irene L. Gomberg, *Young Doctorate Faculty in Selected Science and Engineering Departments, 1975 to 1980*, (Washington, D.C.: American Council on Education, Higher Education Panel Reports, Number 30), 1976.

Source: American Council on Education and National Science Foundation

recent doctorates in 1978.[7] Physics departments alone account for one-fourth of this number (chart 2).

For the 333 departments that responded to each of the four surveys, the total number of full-time doctoral faculty increased by over 14 percent between 1968 and 1978 while the number of recent doctorates decreased by 39 percent. All of the growth was accounted for by the senior doctorates whose numbers increased by 54 percent over the 11-year period. Thus, over the period 1968–78 the number of senior doctorates in these departments has increased more than enough to offset the decline in the number of recent doctorates. Obviously, many of the senior doctorates came from the ranks of those who had been reported as new doctorates in earlier surveys.

Success in Obtaining Research Support

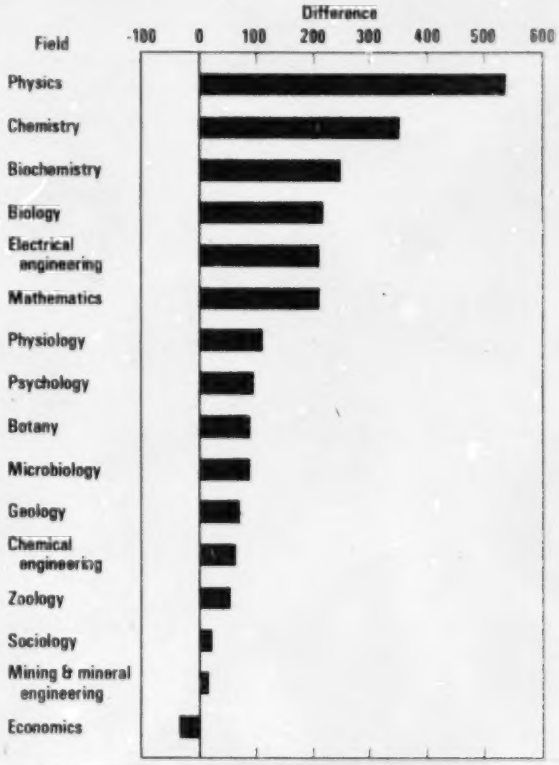
Because of the general belief that young scientists have an important role in the Nation's research enterprise, there is, naturally, concern that they receive a proportionate share of research support. Operationally, this involves two questions: (1) Do recent doctoral S/E faculty submit proposals for research support to the same degree as their senior colleagues? and (2) Do recent doctorates enjoy success comparable to that of their senior colleagues in the competition for funding?

Information was sought for this survey on proposals submitted from July 1976 through June 1977. Necessarily, the analysis must account for the time lapse from submission of a proposal to its disposition by the funding agency. In all cases, at least 10 months had elapsed since the proposals had been submitted. Depending on field, decisions on funding had been made about 84 percent to 94 percent of the proposals.

In 1976–77 the recent doctorates submitted, on average, nearly 20 percent more proposals than did their senior colleagues, 1.02 proposals per recent doctorate compared to .86 per senior doctorate. The greatest differences by field were in botany, chemical engineering, and sociology, with recent doctorates being approximately 70 percent more active than the senior doctorates. Only in one field, electrical engineering, were the senior doctorates the more active group (table 3).

Although recent doctorates generally outpaced senior doctorates in the submission of proposals, they were about as successful in terms of proposals funded. For all fields combined, 55 percent of the proposals submitted by recent doctorates had been funded as of the time of the survey compared to 59 percent for their senior colleagues. For both groups, decisions had not yet been made on slightly over one-tenth of the proposals submitted. Among the individual fields, the recent doctorates in biochemistry and botany were

Chart 2. Difference between actual and desired numbers of recent doctoral faculty in selected doctoral-level departments: 1978



SOURCE: National Science Foundation and American Council on Education

[7] This analysis is sensitive to the assumption that opinions of department heads about desired proportions of recent doctorates have remained stable over recent years. A change of 10 percent (i.e., ± 3 percentage points) would produce a 50-percent change in the deficiency of recent doctorates in 1978.

Table 3. Research proposals submitted by full-tim.. recent and senior doctoral faculty in selected doctoral-level science/engineering departments: 1978

Field	Recent doctorate proposed activity index	Recent/senior success ratio[2]
All selected fields	1.19	94
Biochemistry	1.31	103
Biology	1.41	96
Botany	1.74	104
Chemical engineering	1.69	86
Chemistry	1.59	99
Economics	1.02	93
Electrical engineering	96	85
Geology	1.05	99
Mathematics	1.37	88
Microbiology	1.23	90
Mining & mineral engineering	1.08	73
Physics	1.21	98
Physiology	1.20	90
Psychology	1.22	90
Sociology	1.74	95
Zoology	1.39	93

[1] In each field the number of proposals submitted per senior doctorate individual = 1.00.

[2] Depending on the field, 6 percent to 16 percent of the proposals were not yet decided. In all cases at least 10 months had elapsed since submission.

Source: National Science Foundation and American Council on Education

experiencing slightly greater success in the proportion of funded proposals than their senior colleagues. The least success was experienced by the recent doctorates in mining and mineral engineering.

From the information presented above, it appears that recent doctorates are active in applying for research support. Independent confirmation of this conclusion was provided by department heads, who reported that, in their opinion, recent doctoral faculty are generally more likely to apply for independent research support now as compared with five years ago. This opinion was expressed by 47 percent of the department heads, while an additional 38 percent said that there had been no change.

Expected Full-Time Doctoral Faculty Hires for 1978–79

The heads of the 1,809 departments in 16 S/E fields surveyed reported that in 1978–79 they expect to hire 2,980 doctoral faculty, 8.3 percent of the 1977–78 full-time doctoral faculty (table 4). More than 70 percent of the expected hires, are expected to be assistant professors, most of whom may be expected to be recent doctorates. There is considerable variation among fields in the proportion of expected hires in the assistant professor rank, ranging from 84 percent in microbiology to only 39 percent in mining and mineral engineering. Approximately one-fourth of all the expected assistant professor hires are in mathematics and psychology, two fields that are only slightly below the levels of recent doctorates desired by department heads.

Table 4. Expected full-time doctoral faculty hires by academic rank in selected doctoral-level science/engineering departments: 1978–79

Field	Number	Percent by academic rank: All ranks	Pro-fessor	Assoc. prof.	Ass't. prof.	Other
All selected fields	2,980	100.0	10.3	12.0	70.3	7.4
Biochemistry	177	100.0	14.6	14.5	67.9	3.0
Biology	202	100.0	9.0	6.8	83.0	1.2
Botany	53	100.0	7.3	9.9	80.4	2.4
Chemical engineering	144	100.0	16.0	12.4	71.5	0.0
Chemistry	228	100.0	11.7	11.8	67.3	9.2
Economics	258	100.0	15.1	11.9	69.2	3.8
Electrical engineering	257	100.0	8.1	18.6	71.0	2.3
Geology	95	100.0	15.6	10.4	70.1	3.9
Mathematics	398	100.0	6.1	5.8	62.3	25.9
Microbiology	148	100.0	7.0	8.9	84.1	0.0
Mining & mineral engineering	22	100.0	22.2	38.9	38.9	0.0
Physics	220	100.0	13.4	10.7	59.7	16.1
Physiology	139	100.0	7.0	17.6	66.6	8.8
Psychology	348	100.0	10.8	14.0	73.8	1.4
Sociology	225	100.0	7.6	12.7	74.6	5.1
Zoology	60	100.0	2.2	14.5	76.1	7.2

Note: Because independent weighting procedures were used for each field, detail may not add to total.

Source: American Council on Education

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